CHEMICALS
Project Fact Sheet

In Situ Sensors for the Chemical Industry

Benefits

- Increased system safety, speed, and reliability
- Improved product quality
- Reduced plant costs
- Energy savings potential of 18.5 trillion Btu
- Allows for real-time measurements

Applications

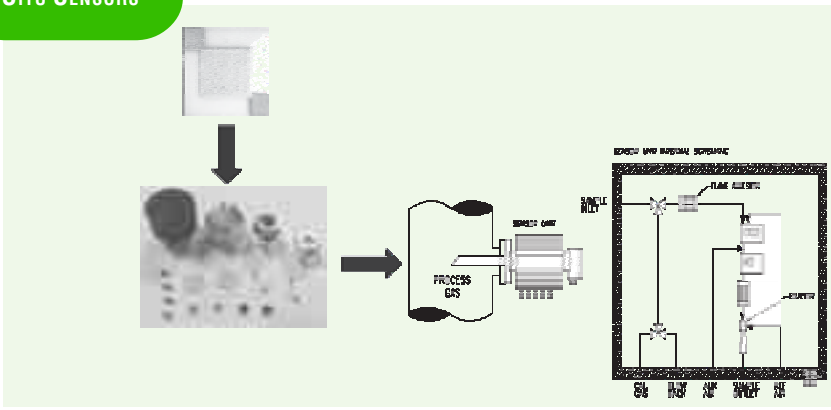
In situ measurements for laser-based and solid-state sensors can be used in a variety of chemical processes and applications. There are thousands of new and old measurement sources in the chemical industry that could benefit from these sensors.

Development of In-Situ Sensors Will Provide Cross Cutting Technology for Advanced Process Control

Reproducible product quality during thermal processing depends on the ability to effectively measure, monitor, and control process heating operations, thus minimizing product variability. This level of control requires reliable and affordable sensors as well as control systems that can withstand harsh environments for minimal time periods without recalibration. With a few exceptions, the current process analytical products of the chemical industry do not allow for in situ application. They require extensive sample conditioning, sample transport, and climate-controlled buildings. This results in serious shortcomings when compared to the needs of today's advanced process control systems. In addition, several commercialization limitations exist for these technologies. Solid state sensors, for example, are not available in the marketplace with the exception of ZrO_2.

Laser-based sensors and solid-state sensors offer significant advantages over currently available process control technologies. The development of analytical platforms based on these sensors will allow for real-time measurements and improved process control of combustion and manufacturing processes, directly reducing energy consumption. Enhanced measurement quality for product manufacturing processes can also increase precision control of product properties to meet market demands. Improved measurement quality for environmental monitors can reduce the environmental impact of manufacturing processes. Additionally, an increase in the number of the measurements available can provide a better understanding of new and existing processes. Enhanced process analytical products have the potential to save as much as 18.5 trillion Btu. These technologies and techniques can reduce emissions and energy use by optimizing system operation. They can also increase system safety and reliability by reducing unforced outages. Their benefits extend into product quality, staffing requirements, and other areas that affect overall plant economics.

In-Situ Sensors



Process flow diagram for the application of in-situ sensors.

Project Description

Goal: To provide a range of in situ process analyzers to enable advanced process control through in situ measurements made using laser-based and solid state sensors.

Process analytical products are divided into single component measurements, multiple component measurements, and multiple component isomer analysis. The strategy is to target single component and multiple component measurements through the use of solid and laser-based sensor platforms, and move these measurements to the process, satisfying many of the process control needs.

The use of solid-state sensors has been limited to zirconia oxygen for in situ process analysis. Technical hurdles include the development of sensors for multiple analytes, including NOx, NH3, hydrogen, and air-fuel ratio. Other hurdles are the development of appropriate sensor chemistries for corrosive service, and the integration of sensors into a form suitable for in situ process analysis. The fundamental issues are the development of appropriate sensor chemistry and integration into an in situ analyzer package.

Laser-based sensors currently have limited specialized use in applications such as NH3 slippage do not have capability for multivariate analysis or a wide range of measurable analytes. Technical hurdles include multi-component measurements, mid infrared analysis, compensation for changing backgrounds, measurement of broadband absorbers, and integration into market acceptable form. Laser sources that are widely tunable and operate in the mid infrared are becoming available. It is necessary to integrate these newly available sources into an acceptable form and to apply simplified chemometrics (multi component, broadband absorbers, and interface rejection).

Progress and Milestones

Research milestones for laser-based and solid-state sensor platforms are outlined below.

Laser-based sensor platforms:

- Hardware/software for general platform
- Sensitivity enhancements
- Multivariate analysis
- Mid infrared analysis

Solid-state sensor platforms:

- Hardware software for general platform
- Sensor design

Commercialization

Analytical Specialties will commercialize the developed products. The company is a supplier of process analyzers, primarily to the chemical and refining industries. The goal is to displace existing technology, offering solutions not previously possible and, most importantly, offering advantages significant enough to encourage replacement of installed analyzers.

Project Partners

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